(11) Application No. AU 2003203735 A1

(19) AUSTRALIAN PATENT OFFICE

(54) Title
A pesticidal agent

(51)6 International Patent Classification(s)
A01N 059/20 **A01N 059/14**
A01N 059/16

(21) Application No: **2003203735** (22) Application Date: **2003.04.17**

(30) Priority Data

(31) Number	(32) Date	(33) Country
PS1803	2002.04.19	AU

(43) Publication Date : **2003.11.06**
(43) Publication Journal Date : **2003.11.06**

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ABSTRACT

The use of copper and/or zinc borate solubilised in an acidic solvent as a pesticidal agent is described. The pesticidal agent is administered to an area in need of protection from pests. After administration, the acidic solvent is allowed to evaporate to afford a substantially water insoluble residue of copper and/or zinc borate.

TITLE

A PESTICIDAL AGENT

FIELD OF THE INVENTION

The present invention relates to a pesticidal agent.

BACKGROUND OF THE INVENTION

Both metallic copper and copper salts are known for their activities as pesticidal, fungicidal, algaecidal, and molluscidal agents. In relation to molluscidal activity, metallic copper and copper salts are effective by surface contact with the mollusc, wherein the structure of surface cells is altered, thus disrupting the normal exchange of gases and liquids. It is thought that copper interferes with the osmo-regulatory and possibly with the oxygen physiology of the mantel epithelium of molluscs, such as snails. Thus, copper exerts its toxic effect on the external epithelia of the snail rather than internally.

Soluble copper salts, such as copper sulfate, copper acetate, and copper chelates, have long been available to the home gardener to be applied in the form of an aqueous spray or distributed as a finely ground powder to form a barrier protection around young plants against snails and slugs, or as fungicides and algaecides. However, soluble copper salts have to be frequently applied to areas at risk to snails, slugs, insects, fungi or algae because the salts are readily leached away.

It is also known to administer insoluble copper powders to areas at risk to snails, slugs, insects, fungi or algae, but they are difficult to apply precisely and easily dispersed by wind and rain action.

Borates are also known for their long-lasting protection against insect and fungal attack. However, high solubility borates such as alkali metal borates and boric acid are also readily leached away from the area in need of prolonged protection. Copper and zinc borates, on the other hand, have very low solubility in aqueous media. They can be administered in the form of a fine powder but are subject to dispersion by wind and rain action.

The present invention attempts to overcome at least in part some of the aforementioned disadvantages.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the invention there is provided a pesticidal agent, comprising a copper and/or zinc borate solubilised in an acidic solvent, wherein the pesticidal agent is administered in liquid form to an area in need of protection from pests, so as to afford a substantially insoluble residue of copper and/or zinc borate in the area upon evaporation of the acidic solvent.

In accordance with a second aspect of the invention there is provided a method of producing a pesticidal agent wherein copper and/or zinc borate is an active agent of the pesticidal agent, the method comprising reacting a copper and/or zinc salt with boric acid and/or an alkali borate in an acidic solvent to produce copper and/or zinc borate solubilised in an acidic solvent.

In accordance with a third aspect of the invention there is provided a method of protecting an area from pests, comprising administering a pesticidal agent to an area in need of protection from pests, wherein the pesticidal agent comprises copper and/or zinc borate solubilised in an acidic solvent.

DESCRIPTION OF THE INVENTION

The pesticidal agent of the present invention may be prepared according to a method wherein a copper and/or zinc salt is reacted with boric acid and/or an alkali borate in an acidic solvent to produce copper and/or zinc borate solubilised in an acidic solvent. Typically, aqueous solutions of the copper and/or zinc salts are mixed with aqueous solutions of boric acid and/or an alkali borate in an acidic environment to discourage precipitation of copper and/or zinc borates in solution.

Examples of copper salts which may be used in the present invention are copper sulphate pentahydrate, copper nitrate, copper chloride, copper acetate, and other water soluble copper salts. The copper salt is generally used in a concentration in the range from 0.1 to 25 % w/w, although the upper limit may vary depending on the limits of water solubility of the specific copper salt used to prepare the pesticidal agent. Additionally, copper metal or copper salts that are substantially insoluble in water unless an acidic solvent is present may be used. Examples of such insoluble salts are copper oxides, copper citrate, copper benzoate, copper phosphates and tribasic copper sulphate.

Examples of zinc salts which may be used in the present invention are zinc oxide, zinc sulphate, zinc nitrate, zinc chloride, zinc acetate, and other water soluble zinc salts. The zinc salt is generally used in a concentration in the range of 0.1 to 25 % w/w, although the upper limit may vary depending on the limits of water solubility of the specific zinc salt used to prepare the pesticidal agent. Additionally, zinc metal or zinc salts that are substantially insoluble in water unless an acidic solvent is present may be used. Examples of such salts are zinc silicate, zinc citrate, zinc formate, zinc benzoate, zinc hydroxide and zinc phosphates.

The solubilised solution of copper and/or zinc borate may be produced by addition of boric acid and/or an alkali borate to the acidic solvent containing the copper and/or zinc salts. Examples of alkali borates which may be used in the present invention are sodium tetraborate decahydrate, ammonium borate, potassium borate, and other water soluble borate salts. Boric acid or the alkali borate salt is generally used in a concentration range of 0.1 to 25 % w/w, although the upper limit may vary depending on the limits of water solubility of the specific alkali borate used to prepare the pesticidal agent.

Glacial acetic acid dissolved in water is typically used as the acidic solvent because it readily volatilises or evaporates under ambient conditions once the pesticidal agent has been administered to the desired area in a liquid or a gel form, thereby leaving an insoluble residue of copper and/or zinc borate. However, other weak organic acids that encourage the solubilisation of copper and/or zinc borate in aqueous solution may also be suitably used.

Typically, the concentration of glacial acetic acid is 0.1 to 25 % w/w.

The pH of the liquid form of the pesticidal agent is typically between 3 and 6, preferably between 4 and 5.5.

In its liquid form, the pesticidal agent of the present invention may be administered to an area in need of protection from pests by spraying or topical application of the pesticidal agent. Upon evaporation of the acidic solvent under ambient conditions, an insoluble residue of copper borate and or zinc borate is afforded on the surface of the area that has been sprayed or to which the pesticidal agent of the present invention has been topically applied. Depending upon the porosity of the surface, it is envisaged

that the surface may absorb the pesticidal agent thereby providing an invasive barrier, particularly against fungal and algal growth on the surface.

Further, the can be prepared in a gel form according to the method wherein a copper and/or zinc salt is reacted with boric acid and/or an alkali borate and a gelling agent in an acidic solvent. In a preferred embodiment the gelling agent is xanthan gum or any other acid stable thickening agent.

There are several advantages in administering the pesticidal agent in the gel form, not least among them the improved ability to precisely administer the pesticidal agent to the desired area in need of protection from pests and to reduce spillage and unwanted dispersion of the pesticidal agent.

The pesticidal agent may also contain other additives that are typically incorporated into the liquid and/or gel forms of the pesticidal agent such as surfactants, colorants, fixing agents, and perfumes.

It is envisaged that the pesticidal agent will be active against fungi, algae, insects, snails, slugs, and other molluscs.

It is also well known that zinc borate behaves as a fire retardant. Additionally, copper borate and mixed copper zinc borate complexes will act as fire retardants and preservatives for wood and other cellulosic materials. It is envisaged that the pesticidal agent of the present invention comprising solubilised zinc borate, copper borate or mixed zinc copper borate complexes could be readily administered to insulating materials, whereby the materials are impregnated with zinc borate and afforded a fire retardant activity.

The invention will now be further described with reference to the following examples.

Example 1 - *Sprayable snail and slug repellent*

Copper sulfate pentahydrate (10 g) and sodium tetraborate decahydrate (15 g) are stirred in approximately 900 mL of distilled water. Glacial acetic acid (10 mL) is then added and the mixture is stirred until the solution appears clear. A surfactant, such as fatty alcohol ethoxylate (2 g) is then added with full dissolution occurring within 10 minutes. The resulting solution is made up to 1 L with distilled water.

The pesticidal agent was sprayed in a band around a moisture and food source and allowed to dry to afford a dry residue of copper borate. Two populations of *Helix aspera* (common garden snail) and *Theba pisana* (Italian white snail) were segregated from the moisture and food source, and their migration and mortality rates were monitored over a 72 hour period.

i) All *Helix aspera* snails migrated across the band of pesticidal agent within the monitored time period. All left a residual slimy effusion following contact with the barrier. All specimens subsequently died.

ii) Approximately 80% of the *Theba pisana* migrated to the moisture/food source. Those contacting the band of pesticidal agent showed similar foot slime effusion. Approximately 50% of these specimens died within the allotted time period.

Example 2 - *Sprayable algaecide/fungicide/molluscide*

Zinc oxide (1.25 g) was stirred with glacial acetic acid (10 mL) and water (10 mL) until the zinc oxide salt fully dissolved. The resulting zinc oxide solution was then added with stirring to a solution of copper sulfate pentahydrate (10 g) and sodium tetraborate decahydrate (15 g) mixed in approximately 900 mL of distilled water. The mixture was stirred until the solution appeared clear. A surfactant, such as fatty

alcohol ethoxylate (2 g) was then added with full dissolution occurring within 10 minutes. The resulting solution was made up to 1 L with distilled water.

The resulting solution is suitable to administer as a spray and exhibits repellent and pesticidal activity against algae, fungi, and molluscs such as snails.

Example 3 - *Snail and slug barrier*

Copper sulfate pentahydrate (10 g) and sodium tetraborate decahydrate (15 g) are stirred in approximately 500 mL of distilled water. Glacial acetic acid (10 mL) is then added and the mixture is stirred until the solution appears clear. A surfactant, such as fatty alcohol ethoxylate (2 g) is then added with full dissolution occurring within 10 minutes. Xanthan gum (20 g) is predissolved in approximately 400 mL of distilled water and added to the solubilised copper borate solution. The resulting solution is made up to 1 L with distilled water.

The resultant gel product is topically applied to the surface to repel snails and slugs.

Example 4 - *Sprayable algaecidal waterproofing treatment for masonry.*

Zinc oxide (1.25 g) was stirred with glacial acetic acid (18 mL) and water (10 mL) until the zinc oxide salt fully dissolved. The resulting zinc oxide solution was then added with stirring to a solution of copper sulfate pentahydrate (10 g) and sodium tetraborate decahydrate (15 g) mixed in approximately 500 mL of distilled water. The mixture was stirred for a few minutes until the solution appeared clear. A solution of sodium or potassium siliconate (40 mL of pre-prepared solutions of Dow Corning 772 or 777) in 300 mL distilled water was then added gradually with stirring. The resultant mixture was made up to 1 L with distilled water.

The resultant mixture was sprayed onto masonry. Upon evaporation of the acidic solvent, the masonry is afforded a waterproof coating of an alkali metal siliconate

interspersed with a residue of copper and zinc borate which offers protection against fungal and algal growths on the masonry both at the interface between the masonry and the waterproof coating and also on the exterior of the waterproof coating.

Example 5 – *Algicidal / Fungicidal / Molluscidal Coating*

Acetic acid and zinc oxide was added to water and stirred until the zinc oxide fully dissolved. The resulting zinc oxide solution was then added to a solution of copper sulfate pentahydrate and sodium tetraborate decahydrate mixed in water and stirred until the solution was clear. An acid stable polymer emulsion (eg acrylic emulsion Primal TR407 from Rohm and Haas) was added gradually with stirring until the required volume is attained.

The resultant mixture may be applied to surfaces such as masonry or timber, to provide a clear, weatherproof barrier against slugs and snails upon evaporation of the acidic solvent. The resultant mixture may also be used to afford protection against algal and fungal growth that already exists upon such surfaces and also to retard the onset of further growth of algae and fungi. It is also envisaged that further additives may be included in the mixture, such as dyes or pigments traditionally used in the paint industry. In this manner, the mixture may be applied as a coloured coating that offers protection against pests. It is further envisaged that such a coloured mixture may be used as a marker coating to indicate which areas or surfaces have been treated with the pesticidal agent. For example, a coloured band of pesticidal agent may be applied around trees or vines to prevent snails and slugs from reaching fruit present on these plants. In this manner, it is possible to ascertain which plants have been treated with the pesticidal agent, thus preventing unnecessary re-application of the pesticidal agent.

Modifications and variations as would be apparent to a skilled addressee are deemed to be within the scope of the present invention

CLAIMS

The claims defining the invention are as follows:

1. The use of copper and/or zinc borate solubilised in an acidic solvent as a pesticidal agent, wherein the pesticidal agent is administered in liquid form to an area in need of protection from pests.

2. The use as claimed in Claim 1, in which after administration the acidic solvent is allowed to evaporate to afford a substantially water insoluble residue of copper and/or zinc borate.

3. The use as claimed in Claim 1 or 2, in which the pesticidal agent contains a gelling agent.

4. The use as claimed in Claim 3, in which the gelling agent is xanthan gum.

5. The use as claimed in any one of the preceding claims, in which the pesticidal agent has a pH between 3 and 6.

6. The use as claimed in Claim 5, in which the pesticidal agent has a pH between 4 and 5.5.

7. The use as claimed in any one of Claims 1 to 5, in which the acidic solvent is glacial acetic acid.

8. The use as claimed in Claim 7, in which the glacial acetic acid has a concentration in the range from 0.1 to 25% w/w.

9. A method of producing a pesticidal agent, wherein copper and/or zinc borate is an active agent of the pesticidal agent, the method comprising reacting a copper and/or zinc salt with boric acid and/or an alkali borate in an acidic solvent to produce copper and/or zinc borate solubilised in an acidic solvent.

10. A method of protecting an area from pests, comprising administering a pesticidal agent to an area in need of protection from pests, wherein the pesticidal agent comprises copper and/or zinc borate solubilised in an acidic solvent.

11. The use of copper and/or zinc borate solubilised in an acidic solvent as a pesticidal agent substantially as hereinbefore described in any one of the foregoing examples.

12. A method of producing a pesticidal agent, wherein copper and/or zinc borate is an active agent of the pesticidal agent substantially as hereinbefore described in any one of the foregoing examples.

13. A method of protecting an area from pests, comprising administering a pesticidal agent to an area in need of protection from pests, wherein the pesticidal agent comprises copper and/or zinc borate solubilised in an acidic solvent substantially as hereinbefore described in any one of the foregoing examples.

DATED THIS 17TH DAY OF APRIL 2003.

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